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Description of two new species of the mid-Cretaceous genus †*Tichostephanus* Engel (Hymenoptera, Gasteruptiidae)

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Abstract

The genus †*Tichostephanus* comprises unique apocritan hymenopterans characterized by distinct fore wing venation, featuring a very large submarginal cell, and a "bottle brush"-like sensilla on the ovipositor sheath. Recently, the genus has been transferred from Stephanidae to Gasteruptiidae (Evanioidea). In this study, two new species, †*Tichostephanus qinshubao* sp. nov. and †*Tichostephanus yuchijingde* sp. nov., are described and illustrated based on specimens from mid-Cretaceous Burmese amber. The new species are distinguished from previously described taxa by the length-to-width ratio of the pterostigma; the degree of curvature of vein 1Cu; the shape of the first subdiscal cell; and the presence or absence of transverse striae on the middle part of the pronotum. A key to all five known species of the genus is provided.

Keywords

Apocrita, Burmese amber, fossil, Gasteruptiidae, parasitoid wasps

Introduction

The family Gasteruptiidae comprises 511 described extant species of parasitoid wasps, classified into two subfamilies and six genera (Macedo 2011; Zhao et al. 2012; Tan et al. 2016, 2021). They are characterized by an elongated propleuron, dilated-appearing

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hind tibia, and a slender, highly mobile metasoma (van Achterberg and Talebi 2014). Adults of modern gasteruptiids are free-living nectar feeders (Jennings and Austin 2004), while their larvae develop as kleptoparasites in solitary bee nests, consuming both host offspring and provisions (Zhao et al. 2012; van Achterberg 2013). Interestingly, Cretaceous gasteruptiid fossils from Burmese amber reveal that the extinct members of the family possessed significant morphological and possibly also ecological diversity (Engel 2019; Wang et al. 2024; Ge et al. 2025).

The genus †*Tichostephanus* was first established by Engel (2019) based on a male specimen, †*Tichostephanus hui*, and was initially placed in Stephanidae due to the possession of coronal tubercles. However, subsequent phylogenetic analyses by Wang et al. (2024) demonstrated that the genus is better supported as a member of the Gasteruptiidae, based on key features in its wing venation; slender hind femur; apically flattened hind tibia, and metasomal structure, a conclusion further supported by Ge et al. (2025). The discovery of female specimens unveiled a remarkable autapomorphy: a unique "bottle brush" of plate-shaped sensilla on the ovipositor sheath, suggesting specialized host-detection capabilities for parasitizing wood-boring insects (Wang et al. 2024).

Herein, we describe two new species of this genus from Burmese amber: †*Tichostephanus qinshubao* Ge & Tan, sp. nov. and †*Tichostephanus yuchijingde* Ge & Tan, sp. nov.

Material and methods

New materials examined

All amber specimens described in this study originate from the Hukawng Valley, Kachin State, Myanmar. They were acquired before 2017 and form part of the Si-Xun Ge's Collection, deposited at the College of Forestry, Beijing Forestry University (**BFU**), China.

Specimens were observed and photographed using a Canon G9 camera mounted on an Olympus CX31 microscope. Illustrations were prepared with Adobe Photoshop CS6, and final plates were assembled in Adobe Photoshop CC. Morphological terminology follows Engel and Grimaldi (2004) and Engel et al. (2013), Wang et al. (2024) with abbreviations adopted from Ge et al. (2023).

Results

Systematic palaeontology

Order Hymenoptera Linnaeus, 1758.
Superfamily Evanioidea Latreille, 1802.
Family Gasteruptiidae Ashmead, 1900.

Genus †*Tichostephanus* Engel, 2019

Type species. †*Tichostephanus hui* Engel, 2019.

Differential diagnosis. Head with distinct coronal tubercles. Fore wing with first discal cell absent. Ovipositor sheath elongated, with "bottle-brush-like" bristles densely developed apically.

Diagnosis. Antenna in males short and robust, with 14 antennomeres; while in females comparatively long and slender, with 13 antennomeres. Head with two unpaired anterior tubercles situated at frons, and three pairs of distinct coronal teeth situated around the ocellus; veins of fore wing strongly reduced; pterostigma distinct elongate and acute apically; vein 1Rs/1M straight, vein 2Rs+M and 1m-cu continuous, forming straight elongated vein between anterior apex of subdiscal cell to origin of 2-Rs, forming large submarginal cell; vein M does not reach the wing margin; vein A extended beyond 1cu-a and almost reaching 2Cua; hindwing with cu-a absent. Hind femur slender; hind tibia strongly swollen-appearing distally; hind tarsus 5-segmented. Metasomal articulation situated slightly lower on the propodeal dorsum; first metasomal sternite not fused with first tergite. Ovipositor slightly longer than metasoma. Ovipositor sheath elongated, with "bottle-brush-like" bristles densely developed apically. Male with genitalia protruding. Parameres tapering apically to broadly rounded apex, with fringe of setae developed along inner margin; gonostipes broadly attached to paramere except apically distinct and tapering to narrowly rounded apex; volsella with long, curved, apical lobe approaching apex of Gonostipex; aedeagus tubular, slightly narrower than paramere, not extending beyond paramere apex.

Key to species of †*Tichostephanus*

1 Vertex with distinct coronal tubercles (Figs 2A, 4A); petiole consists of only one segment (Figs 2E, 4E) **2**

– Vertex without distinct coronal tubercles (Wang et al. 2024: fig. 3. (b)); petiole consists of two segments (Wang et al. 2024: fig. 3. (b)) .... **†*Tichostephanus longus* Wang, Vilhelmsen, Rasnitsyn & Gao**

2 Vertex with distinct large and deep protrusion area behind coronal tubercles, almost reaching occipital carina (Wang et al. 2024: fig. 2. (c)); fore wing veins 1Rs and 1M at a different angle (Wang et al. 2024: fig. 2. (i)) .... **†*Tichostephanus kachinensis* Wang, Vilhelmsen, Rasnitsyn & Gao**

– Vertex largely smooth or coriaceous without strong rugose or protrusion area behind coronal tubercles (Figs 2A, 4A); fore wing veins 1Rs and 1M forming a straight line (Figs 2D, 4D) **3**

3 Vein 1Cu slightly curved distally, curvature directed towards the posterior margin; first subdiscal cell approximately rectangular; vein 2Cu-a nearly perpendicular to vein A (Fig. 2C, D); pterostigma rather elongated and narrow, more than 11 × as long as its maximum width **4**

– Vein 1Cu straight; first subdiscal cell parallelogram shaped; vein 2Cu-a oblique to vein A (Fig. 4C, D); pterostigma comparatively broad, less than 10 × as long as its maximum width ..... **†*Tichostephanus yuchijingde* Ge & Tan, sp. nov.**

4 Middle part of pronotum with several distinct transverse striae (Engel 2019: fig. 1B); pterostigma about 11 × as long as its maximum width (Engel 2019: fig. 2B) ..... **†*Tichostephanus hui* Engel**

– Middle part of the pronotum smooth and shiny (Fig. 2B); pterostigma about 12 × as long as its maximum width (Fig. 2C, D)..... .....**†*Tichostephanus qinshubao* Ge & Tan, sp. nov.**

†*Tichostephanus qinshubao* Ge & Tan, sp. nov.

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Figs 1, 2

Holotype. BFU, Myanmar Amber, Cretaceous. Part of Si-Xun Ge's collection. Sex unknown.

This specimen was previously included in the phylogenetic analysis of Ge et al. (2025) as '†*Tichostephanus* sp1'.

Etymology. The genus-group name is a combination of the Greek words *teichos* (meaning 'city wall'). The new species was named after a famous minister of the Tang Dynasty (who is also one of the door gods in Chinese culture).

Diagnosis. The new species can be distinguished from all other congeners by the following combination of character states: Neck (modified and more or less narrowed anterior part of pronotum) with two distinct carinae and at distinct lower

Figure 1. Habitus of Holotype. †*Tichostephanus qinshubao* Ge & Tan, sp. nov.

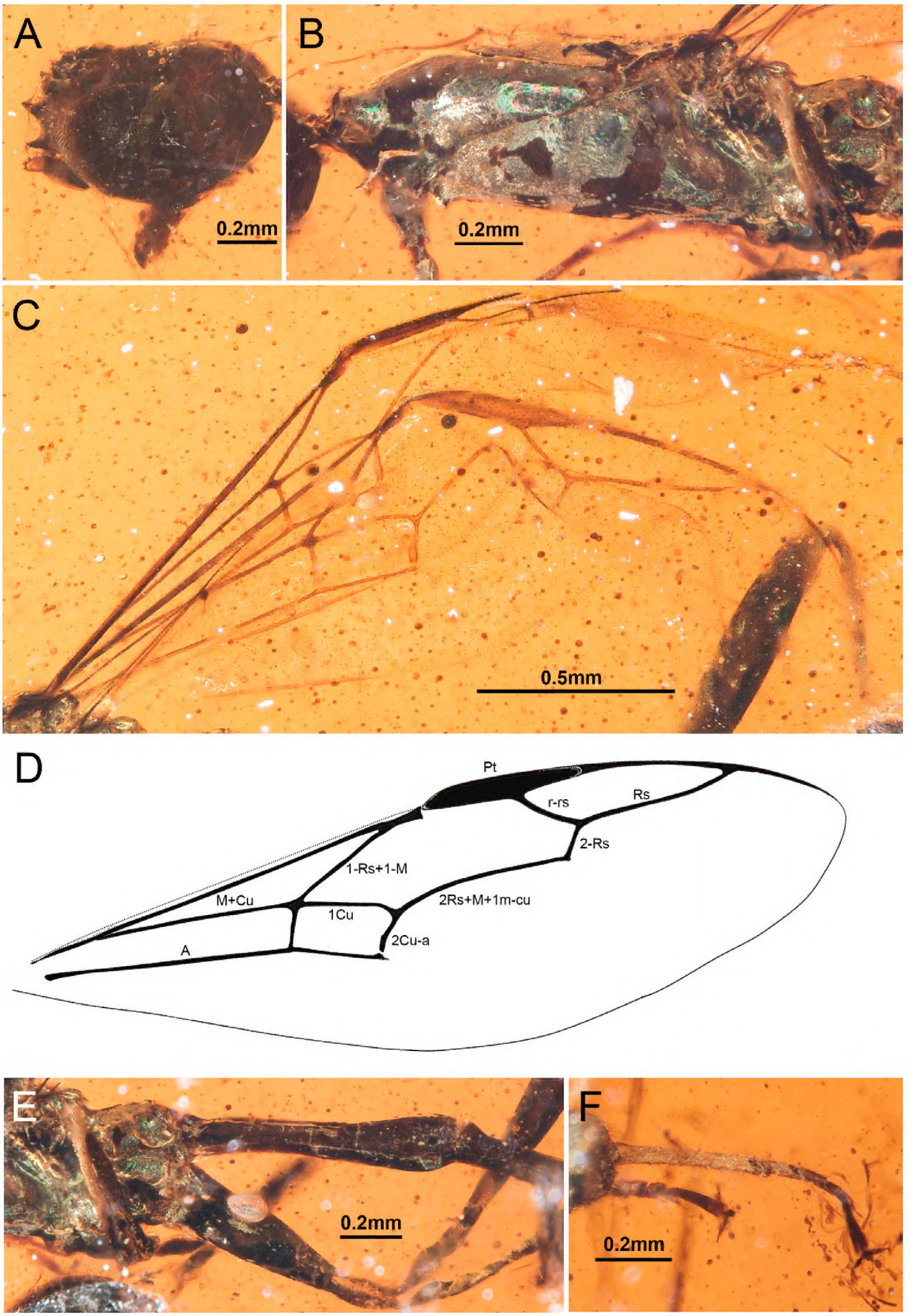

Figure 2. †*Tichostephanus qinshubao* Ge & Tan, sp. nov. Holotype. **A** head, lateral view **B** mesosoma lateral view **C, D** wings **E** propodeum and Tergite I lateral view **F** hind tarsus.

level than middle part of pronotum from lateral view. The posterior part of the pronotum is slightly ascending above the middle part in lateral view. Pterostigma elongate and narrow, about 12 × as long as its maximum width. Vein 1Cu slightly curved distally, curvature directed towards the posterior margin; first subdiscal cell approximately rectangular.

Description. Sex unknown because antenna and genitalia are not preserved. Body length (only partially preserved part because of the destroyed metasomal apex) 6.2 mm; fore wing length ca. 2.4 mm.

Head (Fig. 2A): Antennae missing, head globular, compound eyes occupying about 2/3 of lateral surface; vertex with two unpaired anterior teeth distinctly developed, followed with three pairs of distinct coronal teeth on upper frons and vertex around ocelli; temple more or less bulging; occipital carina distinctly developed. Maxillary and labial palpi not observed.

Mesosoma (Fig. 2B): Pronotum robust with neck differentiated; neck at lower level than middle part of pronotum posterodorsally; neck with two distinct carinae, middle and posterior part of pronotum smooth (as laterally); middle part of pronotum weakly differentiated from posterior part; posterior part of pronotum and mesonotum with sparse setosity; scutellum slightly raised above mesonotum, at least partially smooth.

Wings (Fig. 2C, D): Fore wing with vein 1Rs and 1M merged and straight; 2-Rs, 2Rs+M and 1m-cu merged as continuous (i.e. vein 2Rs+M+1m-cu) vein; pterostigma elongate and narrow, about 12 × as long as its maximum width; vein Rs complete and sclerotized; vein M does not reach the wing margin; subdiscal cell parallel-sided with vein 1Cu parallel to vein A; vein A extended to 2Cu-a; 2Cu-b entirely absent. Hind wing hyaline and clear with only Sc+R present.

Legs (Fig. 2E, F): All legs elongate and comparatively slender, without distinct sculpturing; hind coxa comparatively robust, spindle shaped without distinct striae; hind femur slender without ventral dentition, about 8.6 × as long as its maximum width; hind tibia distinct flattened apically; inner side of widened part not concave basally; hind tibia about 1.2 × longer than hind femur, with maximum width of apical widened part more than 6 × as wide as minimum width of basal narrow part; hind tarsus with five tarsomeres; basitarsus 7.5 × as long as wide.

Metasoma (Fig. 2E): Metasoma incompletely preserved. First tergum and sternum not fused laterally; tergite I slender but with apical part more or less swollen, more or less conical shaped; tergite I indistinctly narrower than tergite II.

†*Tichostephanus yuchijingde* Ge & Tan, sp. nov.

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Figs 3, 4

Holotype. ♂; BFU, Myanmar Amber, Cretaceous. Part of Si-Xun Ge's collection.

This specimen was previously included in the phylogenetic analysis of Ge et al. (2025) as '†*Tichostephanus* sp2'.

Figure 3. Habitus of Holotype ♂. †*Tichostephanus yuchijingde* Ge & Tan, sp. nov.

Etymology. The new species was named after a famous minister of the Tang Dynasty (another door god besides Shubao Qin in Chinese culture).

Diagnosis. The new species can be distinguished from all other congeners by the following combination of character states: Neck with at least two distinct carinae, at slightly lower level than middle part of pronotum from lateral view. Pronotum with posterior part distinctly ascending at a higher level than the middle part from the lateral view. Pterostigma elongated but comparatively broad, less than 10 × as long as its maximum width. Vein 1Cu straight; first subdiscal cell parallelogram shaped; vein 2Cu-a oblique to vein A.

Description. Male. Body length (except antenna) 6.4 mm; forewing length 2.1 mm.

Head (Fig. 4A): Antenna comparatively short and robust, with 12 flagellomeres; scape robust; pedicel short, about as long as wide. Head globular, compound eyes occupying much of anterior portion of lateral surface; vertex with two unpaired triangular tubercles developed anteriorly, followed by three pairs of coronal teeth; Gena slightly bulging; occipital carina distinctly developed; hypostomal carina large, without distinct rugosity but some punctures. Maxillary and labial palpi mostly invisible (basal part concealed).

Mesosoma (Fig. 4B): Pronotum robust with neck differentiated; neck at slightly lower level than middle part of pronotum; neck with at least two carinae, middle and posterior part of pronotum coriaceous; posterior part of pronotum distinctly ascending to higher level than middle part in lateral view.

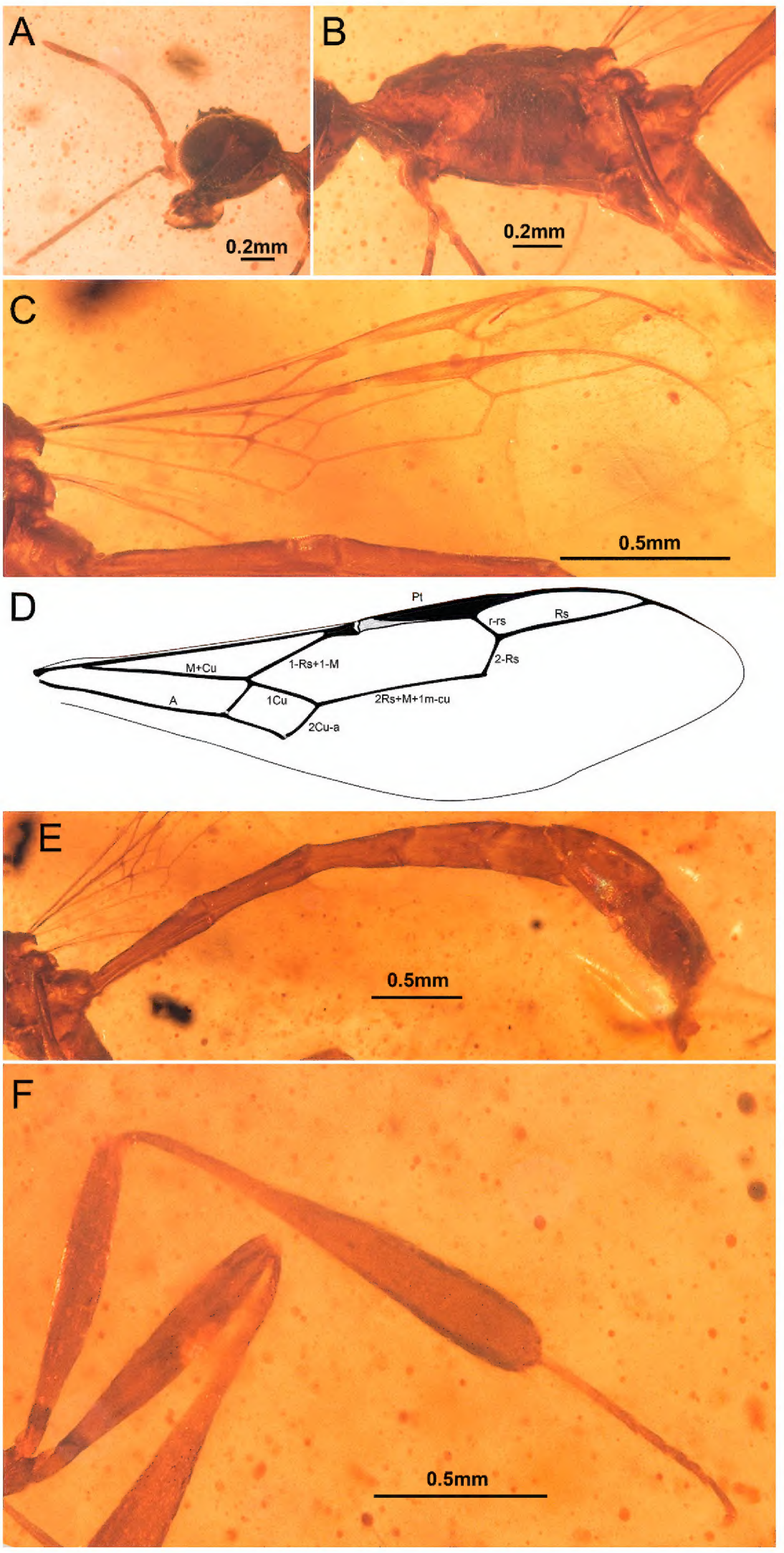

Figure 4. †*Tichostephanus yuchijingde* Ge & Tan, sp. nov. Holotype ♂. **A** head, lateral view **B** mesosoma lateral view **C, D** wings **E** metasoma lateral view **F** hind leg.

Wings (Fig. 4C, D): Forewing with vein 1Rs and 1M continuous and straight; 2-Rs, 2Rs+M and 1m-cu continuous vein (i.e. vein 2Rs+M+1m-cu) with individual veins indistinguishable; pterostigma very elongate but comparatively wide, less than 10 × as long as maximum width; vein Rs complete and sclerotized, reaching distal part of costal margin; vein M does not reach the wing margin; subdiscal cell parallel-sided with vein 1Cu parallel to vein A; vein A extended to 2Cu-a; 2Cu-b entirely absent. Hind wing clear, with only Sc+R present.

Legs (Fig. 4F): all legs elongate and slender, without distinct sculpture; hind coxa robust, spindle shaped without striae; hind femur slender without ventral dentition, about 7.2 × as long as its maximum width; hind tibia with its apical part distinctly flattened; inner side of the apical part without concavity basally; hind tibia about 1.5 × longer than hind femur, with maximum width of apical widened part up to 5.3 × as wide as minimum width of basal narrow part; hind tarsus with five tarsomeres; basitarsus 11.5 × as long as wide.

Metasoma (Fig. 4E): First tergum and sternum not fused laterally, tergite I slender but with apical part more or less swollen, about 1.2 × as long as tergite II and 0.2 × as long as remainder of metasoma; tergite I indistinctly narrower than tergite II. Genitalia only partly exserted, parameres long and broad, with its apex rounded.

Female. Unknown.

Discussion

The genus †*Tichostephanus* has been recently placed within Gasteruptiidae based on reconsidered morphological evidence (Wang et al. 2024; Ge et al. 2025). The two new species described herein, †*T. qinshubao* sp. nov. and †*T. yuchijingde* sp. nov., were previously incorporated in the phylogenetic analysis of Ge et al. (2025) under the temporary designations '†*Tichostephanus* sp1' and '†*Tichostephanus* sp2'. Their positions within the genus were already established and supported prior to their formal description. †*Tichostephanus* now comprises five species with all species share the diagnostic fore wing venation with a large submarginal cell and females with the unique "bottle brush" sensilla on the ovipositor sheath.

Our previous phylogenetic analysis supports the monophyly of †*Tichostephanus* (Ge et al. 2025), suggesting that †*T. longus* is sister to the remaining species. The feature distinguishing †*T. longus* from the remaining species is the lack the prominent coronal teeth present in other congeners. More than that, †*T. longus* has a petiole consisting of two segments, while in other †*Tichostephanus* have only one segment. Nevertheless, †*T. longus* displays key synapomorphies of the genus, such as the specifically reduced forewing venation and the specialized brush-like sensilla on the ovipositor sheath. These suggest that †*Tichostephanus*, as currently defined, is not a natural group, indicating that †*T. longus* may represent a distinct genus. Future fossil discoveries may provide new evidence to further split the genus, recognizing distinct evolutionary branches within this early-diverging clade of Gasteruptiidae.

Declaration of generative AI in scientific writing

During the preparation of this work the authors have not used large language models.

Availability of data and materials

All new fossil specimens are available for re-examination by any researcher on request to Si-Xun Ge.

Competing interests

The authors declare no competing interests.

Author Contributions

Si-Xun Ge: Conceptualization (lead); data curation (lead); formal analysis (lead); methodology (lead); resources (lead); software (lead); visualization (lead); writing original draft (lead). Li-Li Ren: funding acquisition (equal); project administration (equal); resources (equal); supervision (equal); validation (lead); visualization (equal); writing review and editing (supporting). Jiang-Li Tan: conceptualization (equal); methodology (equal); supervision (lead); funding acquisition (lead); validation (equal); writing review and editing (lead).

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